

'I no longer dread teaching physics, I now enjoy it!' Participant reflections from the SASP physics course

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‘I no longer dread teaching physics, I now enjoy it!’

Participant reflections from the SASP physics course

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Abstract

This article aims to explore some of the experiences of participants on the Science as an Additional Specialism (SASP) physics course. It draws from feedback, assignment work and course evaluations from all of the 22 teachers who were participants on the course at the Science Learning Centre East of England at Bayfordbury, in the 2009–10 academic year. An accompanying article by Peter Campbell describes the genesis and nature of the course together with experiences, mainly from a tutor’s perspective.

Introduction

The SASP physics course has been a significant initiative in the ongoing support for the teaching of physics in England. Taking place over 40 days, its aim is to support science teachers who are not physics specialists to develop and improve their teaching of physics at Key Stage 3 (students aged 11–14) and Key Stage 4 (students aged 14–16). It also aims to start developing the knowledge and skills required for A-level physics teaching (students aged 16–18). Within the limitations of an article of this length, I intend to explore, from the viewpoint of participants, a few themes that were central to the design and planning of the course:

- practical work
- pedagogical and subject knowledge
- the mathematical requirements for teaching physics
- learning in groups
- the impact of SASP on participants.

By focusing on these, as well as the challenges faced by participants and tutors during

the year, it is hoped that this article can offer some messages for future SASP courses as well as continuing professional development (CPD) for non-specialist physics teachers more generally. All quotations have been taken from participant evaluations, communications or assignment-based work. They are anonymous but participants have agreed to their use.

Practical work

Experiencing and developing confidence with practical activities is a key feature of the course and so opportunities for practical activities are maximized during the face-to-face sessions. These could be said to occur in four broad categories:

- demonstrations during tutor-led taught sessions
- workshop activities that the entire group worked through
- optional extra practical activities that participants could select from, including time for familiarization with equipment such as

oscilloscopes, Van de Graaff generators and multimeters

- activities those participants brought in themselves.

Near the start of a course, SASP participants, in discussion and feedback, commonly say both that they lack the confidence to carry out known practical activities and also that they have a limited knowledge of what is possible or suitable. They are unable to apply the same level of thought and preparation as they might in their specialist subject and this adversely affects the quality of their physics teaching. Having reference notes and instructions is seen as very important for participants to feel happy to return to an activity sometime later. The website www.practicalphysics.org was valuable here and SASP participants also videoed and photographed experiments, some of which are available at www.youtube.com/user/VideoSASP and <http://physicssasp.slide.com>.

This aspect of the course was very well received indeed; in the final course evaluation, every single participant mentioned this as one of the strengths of the course, with many being particularly effusive.

The course has supplied us with a wide range of practicals, each was easily reproducible, in terms of ease of set up, simplicity of equipment and accompanying practical sheets. Consequently my confidence in physics practicals has increased greatly and given me a wider library of practical to choose from (Teacher 1)

Both knowledge and confidence has vastly improved in terms of practical work. It has been incredibly useful to have time to 'play' with equipment and develop/hear about novel ways for incorporating practical work, e.g. Audacity, resistance of pencil lines, capacitors with bin bags. The list is endless . . . (Teacher 2)

The value of time to develop confidence with the equipment, think and discuss the benefits and possible challenges with colleagues was highlighted by many.

I feel that the practicals are probably the most important part of the day as they let you have a go before you have to teach them. I rarely get the time to run through a practical before I have to teach it and quite often this lack of familiarity means that things go wrong or poor results are obtained. The opportunity to practise these experiments as a group was fantastically useful. I not only got to work through a practical but could discuss potential pitfalls and ways to avoid them. I feel that the interchange and practice vastly enhanced the theoretical teaching. (Teacher 3)

Participant contributions

The opportunity for participants to bring in their own activities to show and explain to the group adds an extra collaborative dimension to some of the SASP sessions. Notable activities last year included the karate chopping of some tiles and a charge detector made from a plastic cup, cocktail stick and piece of paper. Some participants also took ideas covered in SASP sessions and then generated their own, new activities. These were fed back to the group and tutors, and also used in their own teaching, further enriching the process. Two highlights were a variation of a bed of nails experiment and a conservation of energy experiment based on a ballistic pendulum idea designed to find the energy needed to break a biscuit (figure 1). (All on the previously-mentioned YouTube channel.)

This was one of the real advantages of the course; we got time to see and use the specialist physics kit. Also to develop our own experiments and have them evaluated by the group and the tutors. (Teacher 4)

Pedagogy and subject knowledge

Getting the balance right between a more didactic, subject-knowledge-based approach and more explorative and discursive pedagogical sessions is a challenge for tutors. In some topics, the level of subject knowledge of some participants is quite limited. Even those who have taught physics to students aged 14–16 (and post-16 in some cases) have a restricted breadth of



Figure 1. Bed of nails and the karate chop.

understanding and lack confidence beyond content specified for the exam. Last year many teachers re-evaluated areas where they had previously felt confident as they learned how content at higher levels built upon and relied on it.

The course started off on the topic of electricity at KS3 and static charge. I initially felt confident with this but soon realized that, although I was able to regurgitate what was in the textbook, I lacked deep understanding of the subject. (Teacher 3)

The course was designed to help participants make connections between the core themes that run through the physics content that is taught in England to students from 11 to 18 years old. The hope is that they can develop a view of the 'big picture', facilitating a less disjointed view of physics for themselves and their classes.

The SASP course has changed my understanding of physics as a whole. The way that it has been delivered, considering each topic from Key Stage 3 through to A-level, has given me a real appreciation of where my GCSE teaching fits in. At different points throughout the course the 'big idea' was identified and continually referred back to. This has given me a clearer idea of the progression of concepts throughout the Key Stages. As a result I feel my teaching has improved and I am preparing my triple students, in particular, to continue their studies into A-level. (Teacher 5)

I now start a topic with a timeline of teaching to show where it goes from KS3 to A-level or vice versa. (Teacher 6)

Equally, opportunities for teachers in school to discuss pedagogy are limited, often simply as a result of time pressures.

I was initially unsure as to what to expect for pedagogical knowledge. It has been really good to review pedagogical approaches as this is an aspect of teaching which is often overlooked. (Teacher 5)

It is the range of pedagogical techniques that have transcended my physics teaching into my teaching of other aspects and subjects which has given me the most satisfaction. As a reflective practitioner the worst possible feeling is staleness in your teaching and this year's course has allowed me the time, energy and confidence to try out new strategies and discuss issues with like-minded people (away from the normal rigmarole of everyday science department life). (Teacher 7)

The assignment structure creates a framework that requires participants to engage with and reflect upon subject and professional practice literature throughout the course and tutors integrate this into sessions. The wider approach of SASP is to integrate the 'what to teach' with the 'good ways to teach it' so that they were not seen as discrete things. The focus for tutors is to support the development of professional pedagogical subject knowledge (Loughran *et al* 2004, Shulman 1986)

for participants, enabling quality physics teaching. This approach has impacted on many participants.

Notes from my reflective journal kept throughout the course indicated that in trying to improve my subject knowledge, I was introduced to many different materials and resources that are useful in not only improving my subject knowledge but are aiding me to vary and improve my teaching styles. (Teacher 8)

It was really good to improve pedagogical and subject knowledge side by side—as it added so much more to the teaching of physics. (Teacher 9)

I definitely feel that I know how to teach physics better now and will plan my lessons in a better order to account for misconceptions and future learning much more than I would have in physics before. With all the sharing of good practice my pedagogical knowledge has definitely improved as well from this. (Teacher 10)

The level of pedagogy in the course is very useful in continuously refining and developing classroom practice, after studying for a PGCE the SASP course has allowed me to develop further my pedagogical skills and I believe pupils are more engaged on average now in my lessons than before I started SASP. (Teacher 11)

The new pedagogical approaches and reactions to my physics teaching from the students have also enabled me to improve my physics and general teaching. I now have a much greater understanding of the misconceptions and areas that students find difficult when learning physics. This has impacted upon not only the ways that I teach individual lessons but also on how I plan lessons and schemes of work. (Teacher 12)

My initial scepticism that the pedagogical element of the SASP course was not relevant melted away when I realized it was informing my teaching and planning of my lessons. SASP was able to offer a variety of strategies and skills

to strengthen my own pedagogic content knowledge. This came not only from the course and course tutors but also from the participants themselves. Each participant had a strength in each area and pooled together this has produced the biggest library of teacher resources and teaching methods. This is invaluable in a profession where teachers are generally too busy to share good practice. (Teacher 13)

The mathematical requirements for teaching physics

The mathematical requirements for physics, particularly post-16, and how best to teach and support this for students is an area that has been discussed over many years (Martin 1994, Taber 2009) and was certainly a consideration in the design of SASP. There was a considerable range of experiences and confidences with mathematical techniques within last year's cohort and support for this required extra materials and time that had not been originally planned. Although participants found it challenging, many gained a greater understanding of the connections between maths and physics and how best to deal with this in their own teaching, as well as improving their own confidence.

It was also reassuring to have the maths put into context, by showing us that while we should be rigorous with the process and practice it is important not to let it dominate the learning. (Teacher 12)

One of the key eye-openers was 'SUVAT'. I had not come across this idea before and it enabled me to be able to work out previously impossible questions. [...] I got real satisfaction from being able to work out the calculations. It felt that I had power over the maths for once rather than it intimidating me. (Teacher 14)

During my days on the SASP course I started to spend time manipulating equations and I can now do this successfully. However, I can sympathize with a lot of the students that I teach as maths is not my strongest subject and

I have always struggled with algebra. (Teacher 15)

Early in the course I was drawn to the idea of becoming comfortable with the ideas behind the topics before moving to the mathematics, and having tried these methods out, it has become clearer that the purpose of the mathematics should be to continue the logical reasoning which starts with concrete and imaginary models of the concepts under consideration. As a topic develops, there comes a point when mathematics supports further investigation, and that is the time to introduce it. I found a resonance here in the way I approach biology and chemistry topics, and felt I had been 'given permission' by the course to ignore the mathematics for a while in physics as well. I have developed this method of working during the course and found a very positive response from the students. (Teacher 16)

Learning in groups

Another feature of the course design is group-based activities, enabling participants to work together on tasks, either prescribed or more open. Tutors try to create a supportive environment where all feel able to ask questions and query whatever they feel necessary. The year-long nature of SASP allows this professional discourse to develop and benefit both tutors and participants in a way that is not possible in many CPD settings.

One of the best aspects of this course has been the discussions held with other participants as well as the course tutors. It is rare nowadays to have such a long running course that allows significant reflection on the topics taught, a chance to try out new ideas and then time to discuss with colleagues. (Teacher 5)

The duration helped in this regard, a real sense of cohesion developed within the group and included the tutors. This settled group and routine structure allowed people to participate actively throughout the day, and the course benefited greatly from the different inputs

from so many experienced teachers. Discussion was genuine and people were not afraid to admit they didn't understand things or had misconceptions themselves. This is not always easy in teaching, I personally have taught exclusively physics at Key Stage 4 for four years, it is not acceptable in my normal working environment to admit I don't fully understand something which I'm supposed to teach. This has led to me sometimes feeling a bit of a fraud; this course has addressed this and boosted my confidence. (Teacher 4)

Impact on confidence/classroom practice

Perhaps the most critical measure of the effectiveness and value of the course is the impact it has on the participants back in their schools. It is common for someone attending any CPD course to have something good to take back and use in their teaching pretty much straight away. SASP has provided an opportunity for a much richer and deeper engagement with physics education.

My usual, cynical success criteria for CPD is if there is one thing from a course I am using a month later then it was a success: not really a great reflection of CPD in general! I am still using material, knowledge and ideas acquired from the very beginning on the SASP course and I know I will be doing so for the remainder of my teaching career so, based upon my usual criteria, SASP has been a resounding success. (Teacher 17)

My previous experience of CPD has not even come close to that experienced during this course, most of it being mundane exam and coursework requirement 'type' days, more of a matter of necessity than personal or professional development as a classroom teacher. (Teacher 18)

I've been on quite a number of one-day/weekend courses on physics. Even though they are beneficial, none come even close to or compare to the SASP training. SASP has not only improved my knowledge and confidence to teach physics, my pedagogy content knowledge has leapt bounds in terms of content,

concept and approach in physics delivery KS3 up to A-level. (Teacher 19)

In reading the feedback and final assignments that participants produced reflecting upon the year and its impact on them, I have been quite moved by the impact the course has had on them.

[I am now] much more confident about content, more animated, interested and look forward to teaching [physics]. (Teacher 20)

I would now apply for a job as a physics teacher confident that I could answer any subject knowledge questions I need to, this is a direct result of attending SASP. (Teacher 11)

I've taken a new job as a physics specialist including teaching A-level. I wouldn't/couldn't have done this without the course. (Teacher 4)

Equally encouraging is the impact the course has had on the participants' departments.

I have run a number of training sessions for other members of the department—sharing ideas and practice that I have learnt on the course. (Teacher 21)

Virtually every department meeting we've had, I've had either practical equipment or online resources to share. (Teacher 2)

I have been able to inspire more enthusiasm to teach physics in a department with no physics specialist. (Teacher 9)

Never before has CPD had such an impact on my motivation, subject knowledge and pedagogy. The added bonus is that the positive effects have not just been limited to my professional development. Through discussion and reflection with colleagues in school, they and the students they teach have also benefited. (Teacher 2)

Perhaps most important are the effects the course has had on students.

I have found that my ability to interact with the students to check understanding has also improved markedly as I have become more confident in the subject.

Whereas before I was wary of loose and open discussions my confidence is such that I no longer have this issue. What this means is that under the guise of a general and informal discussion I can now get a useful insight into levels of understanding and areas they have obviously had problems with. (Teacher 3)

As my subject knowledge has grown, my style of teaching physics has changed immensely. I am now more secure with my subject knowledge so I am more confident in my teaching. For example I feel more able to set open enquiry practical work and hold discussions as I feel I am now able to address any questions or queries relating to equipment etc. This has had an enormous impact on my students' learning. (Teacher 9)

Challenges, lessons learnt and developments

The comments used here are all from participants at the Science Learning Centre East of England (figure 2) and as such present a limited view, however tutors from the other two regional Science Learning Centres (based in London and Sheffield) reported similar feedback from participants as well as experiencing similar challenges and rewards themselves.

Although the feedback from East of England participants was overwhelmingly positive, the year was demanding and, at times, frustrating for both participants and tutors. To make the course successful, it needed constantly to respond to feedback. Participants soon became confident about asking questions of all kinds, challenging aspects of the course itself and, perhaps most importantly, being honest if they were struggling.

The atmosphere as the course progressed was a very safe one in which to raise problems and concerns, and I felt that the group was very supportive. (Teacher 16)

Once the participants got to know the tutors well, any embarrassment in 'owning up' to not knowing something or inhibition about asking questions soon disappeared.



Figure 2. The SASP 2009–10 group at the Science Learning Centre East of England.

[all the days were] informative and interesting, even when we heckled!!!—which was often (Teacher 20)

The course's mathematical demands caused considerable frustration and, at times, disheartened quite a few participants, particularly with post-16 topics. As a tutor, I had underestimated the range of confidence and experiences here, so found myself responding to needs in a more reactive than proactive way. I have taken a more structured approach with the 2010–11 cohort, teaching key maths skills before they arise within a relevant physics context. So far this year, participants seem less troubled by the mathematical demands.

Perhaps the biggest challenge has been accommodating the large spread of subject knowledge and prior teaching experiences to ensure that each day is relevant and valuable for everyone. Almost a third of the teachers in the 2009–10 cohort had been teaching for over 10 years, and some already had experience of teaching physics post-16. Early feedback from some teachers, across the ranges of confidence and experience, indicated that they wanted, each day, a more intense, tutor-led session covering the subject knowledge.

In response, we revised the structure of the day so that it generally began with a tutor-led teaching session, followed by more flexible sessions when participants could select

from a range of activities, both experimental and problem-solving. This made participants responsible for identifying areas which they felt needed attention and becoming sufficiently secure with them. This flexibility was important particularly for these who wished to spend more time on post-16 content or those who wanted to feel more secure in pre-16 content. Whilst creating extra work for tutors in collecting and preparing an appropriate and relevant range of activities, this approach was well received and valued by participants.

Concluding comments

A recent online discussion about SASP physics included this contribution from one participant:

This route [SASP] has transformed colleagues, before my very eyes, from hesitant and confused but willing adventurers, into confident and motivated aspirant physics teachers. They have wrestled with, and overcome, most of the tricky conceptual problems (that many a graduate physicist has glossed over in the rush to get the calculated answer right). (Teacher 22)

This reminds us that whilst the end of the year is not the end of the story, the SASP course provides a model that can take committed and enthusiastic biology or chemistry teachers and

start to empower and equip them to become fine physics teachers too.

It is clear SASP physics is a significant challenge for both tutors and participants but is, equally, tremendously rewarding for all involved. The commitment levels and financial investment are significant but so too are the benefits. Most teachers who have completed the course across all three Science Learning Centres regard it as a CPD experience that has positively and significantly transformed their teaching of physics. This success owes much to the efforts, enthusiasm and commitment of the participants, whom all tutors wish the very best with their new (dual) identities.

I no longer dread teaching physics, but I now enjoy it! (Teacher 9)

And I would add

‘... and you are doing it well.’

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